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ABSTRACT

This study was conducted to examine the effects of instruction administered through written and visual symbol systems on the achievement, confidence, attitudes, time-on-task, and retention of formal and distance education students. The sample for the study consisted of 161 undergraduate students from formal and distance education settings. Subjects were divided into three groups and asked to study the materials during a week. The first group studied materials that included only written symbol systems, the second group visual symbol systems, and the third group both written and visual symbol systems. After studying the materials, the subjects completed an achievement test and a Likert type attitude scale. Two weeks later, an identical achievement test was administered again to determine the retention of learning. Results indicated that different forms of symbol systems had different effects on students' achievement, confidence, and retention of learning. Attitudes of subjects were positive toward the symbol systems that they studied. More specifically, distance education students reacted positively toward both the written and visual symbol systems, while formal education students reacted positively only to written symbol systems. (Contains 19 references.) (Author/AEF)

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Effects of Instruction Administered Through Written and Visual Symbol Systems on the Achievement of Formal and Distance Education Students

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Abstract

This study was conducted to examine the effects of instruction administered through written and visual symbol systems on the achievement, confidence, attitudes, time-on-task and retention of formal and distance education students.

The sample of the study consisted of 161 undergraduate students from formal and distance education settings. Subjects were divided into three groups and asked to study the materials during a week. First group studied the materials that included only written symbol systems, second group visual symbol systems, and the third group both written and visual symbol systems. After studying the materials, the subjects completed an achievement test and a Likert type attitude scale. Two weeks later, an identical achievement test was administered again to determine the retention of learning.

Results indicated that different forms of symbol systems had different effects on student's achievement, confidence, and retention of learning. Attitudes of subjects were positive toward the symbol systems that they studied. Especially, distance education students were positive toward both to written and visual symbol systems while formal education students were positive only to written symbol systems.

Introduction

Symbol systems in information processing are defined as symbolic representations of information and requires interrelation of varying symbol forms such as letters, numbers, formulas, figures, notes, graphics, photographs, etc (Goodman, 1976). Selection of symbol systems to use with different media depends on the nature of media and its technological limitations. Students' selection, processing, storage and recall of verbal, visual or aural symbol systems vary due to their individual differences.

Media in learning process show differences in cognitive information processing in relation to their capabilities, technologies and symbol systems (Kozma, 1991). In other words, an individual utilize varying schemata for defining, processing and storing symbol systems relevant to the characteristics of media.

The schemata in memory are coded either verbally or visually according to characteristics of symbol systems that carry information and recalled back to be used in process of learning new information. Learning occurs with processing of prior and new information in memory as an integrated entity. However, in some situations, new information may not fit into an existing schema and either a new one, appropriate for new information, is constructed or the existing schema is modified in a way that new information can suit. This modification to new information might be possible through gaining attention of students. Thus, symbol systems in instructional materials must be designed carefully to acquire students' attention (Wittrock, 1990).

In the light of this view and explanations of cognitive psychology about information processing, a shift happened in media comparison studies toward studying how learning occurs according to individual characteristics of students. So that it can be revealed how to implement instruction according to available technological facilities.

However, researchers in the field of educational technology have not reached a common consensus on which and how attributes of different media influence learning although debates have been continuing for many decades. Thus, more detailed studies are still needed to clarify this issue. This need is more crucial in the field of distance education that naturally depends on heavily mediated learning activities. The quantity and quality of research studies have done on effects of media on distance learning urges the need.

This study was conducted to examine the effects of instruction administered through written and visual symbol systems on the achievement, confidence, attitudes, time-on-task and retention of formal and distance education students. It is believed that results of the study may help especially distance learning designers and instructors provide more effective, efficient and appealing instructional media to their students.

Purpose of Study

In this investigation, it was sought to clarify the effects of using different media in both distance and formal education on learning outcomes. In other words, this study purposed to determine which symbol systems provide better achievement, higher confidence, lesser time-on-task, positive attitudes, more retention of learning, when used in distance and formal education settings. Specifically, the following research questions were addressed:

1. In which way is the use of different media and symbol systems effective on achievement of students in distance education and formal education?
2. How do distance and formal education students' attitudes toward the media they use and the content they encounter differentiate?

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3. How does the use of different symbol systems influence confidence level toward achievement and retention in distance education and formal education settings?
4. Does the time students spend to complete the task differ according to instructional strategy (distance and formal) and symbol systems?
5. In which way is the use of different symbol systems effective on the retention of learning?

Methodology

This investigation included a 2X3 factorial analysis. The factors can be seen in Table 1. The effects of these dependent variables on formal and distance students' achievements, levels of self-confidence, academic attitudes, time-on-tasks and retention of learning, which is determined at the second test administered two weeks later the first one, are investigated in this study.

Table 1. Factors and Quantity of Participants

Instructional Strategies \ *Symbol Systems*	Written	Visual	Written and Visual	
Distance	n = 28	n = 31	n = 28	87
Formal	n = 25	n = 24	n = 25	74
	53	55	53	N = 161

The sample of study consisted of 161 sophomore students from formal and distance education settings. 87 of these were formal education students majoring in Economics and Business Programs of Anadolu University. Others were also studying in economics and business but they were all in the distance education programs of the University.

A 138 minutes long video program and a 50 pages textbook on same topic, anthropology were used in as the instructional materials of this study. Subjects were divided into three groups and asked to study the materials during a week. First group studied the materials that included only written symbol systems, second group visual symbol systems, and the third group both written and visual symbol systems. It was also asked students record the time they spent on studying the materials. After studying the materials, the subjects completed an achievement test and a Likert type attitude scale. Two weeks later, an identical achievement test was administered again to determine the retention of learning. In addition to these, students indicated their grade expectations on both achievement tests. These were used to determine the self-confidence level of students.

In the process of data analysis, means, standard deviation, Pearson correlation, two way variance analysis and Fisher LSD test were used. Using MS Excel and Systat software completed all these statistical processes. For data analysis .05 Alpha level determined but it was also indicated when a .01 Alpha level determined.

In order to determine the effects of using different symbol systems (written, visual or combination of these) on distance and formal education students, five different instruments about achievement, self-confidence, attitudes, time-on-task and retention of learning were developed.

- **Achievement test:** After studying the materials participants took a 50 items achievement test. 50% of these items were intended to measure students recalling abilities others were comprehension abilities.
- **Self-confidence:** The students were asked to write down what grade they expect to get in the exam before they started to answer the questions. These expectations were used as their confidence levels.
- **Time-on-task:** It was demanded to keep a record of time spent for studying the materials. So that, whether a statically significant difference are there between in time spent for studying and instructional strategy (distance versus formal) or symbol systems through a two-way variance analysis.
- **Attitudes:** A 30 item Likert type instrument were developed to determine the students' attitudes toward symbol systems and the topic they studied. 15 of the items were related to the instructional media and others were about the content.
- **Retention of learning:** Two weeks later, an identical achievement test was administered again to determine the retention of learning. Same as achievement test, it was intended to determine if there is any difference between in the recalling and comprehension levels of students.

Results and Discussion

The results reached in this investigation are given below into four groups.

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Achievement

Results indicated that students in face-to-face education achieved more than the students in distance education. While the groups studying only with the written symbol systems in face-to-face education are more successful, in distance education the groups studying with both written and visual symbol systems together are more successful. This finding might be implying that students use their usual learning styles when they are presented the content in a different material. In other words, using textbooks in face-to-face education as a basic resource results in students' preferring the textbooks and written symbol systems. On the other hand, the fact that students using both written and visual symbol systems in distance education are more successful comparing the other two groups may be caused by their familiarity to the media and determination of which symbol systems to use (Weinstein and Mayer, 1985).

While the remote memorization part of the achievement test imply almost the same results, the comprehension part of it, on the other hand, yields a significant difference. In the comprehension part of the achievement test, those who use both written and visual symbol systems in both traditional and distance learning are more successful than other groups. Research findings related to the effects of presentation of content via different materials and different symbol systems support the literature in general. For example, Bagget and Ehrenfeucht (1983) believed the strength of the use of verbal and visual symbol systems together in increasing the achievement. Also, Pezdek and Hartman (1983) suggest that using audio-visual information together increases the achievement, while Pluss, Leutner, Chu, and Mayer (1998) suggest visual and verbal elaboration in information processing increases the achievement. But these findings have been gathered from the learners in traditional education. On the other hand, findings of this research shows that the students who use only the written symbol systems in face-to-face education scored the highest points on the achievement test. This might be implying that the students in traditional learning usually prefer verbal learning habits in order to create connections in between their previous and new learning.

Confidence

Confidence score means of the students in face-to-face education are higher than those who are in distance education. Correlation between achievement scores and confidence scores was found to be positive and significant.

Research findings, on the other hand, show that there is a difference between successful groups and confidence levels. From the achievement perspective, the group using written symbol systems in traditional education is more successful than the group using both written and visual symbol systems in distance education. From the confidence perspective, the groups using only visual symbol systems had higher confidence levels in both traditional and distance education. This might be an indication of students' perception of visual symbol systems easier and finding the presentation of content more attractive.

Salomon (1979, 1984) compared the printed materials and television in his researches,, and suggested that television is perceived much easier compared to printed materials, but still the learning is not that strong. Similarly, Cennamo, Savenye and Smith (1991) suggest that the way students perceive the medium will make their learning either easier or more difficult depending on their abilities. In this research also, findings support that groups using only the visual symbol systems had higher confidence levels since they perceived the medium much easier.

Attitudes

Attitude score means of students in distance education are rather close to the means of students in face-to-face education. Overall attitude scores for all students are generally high. It can be said that students' attitudes toward the instructional media and content are positive.

In the media part of the attitude scale, both the written symbol systems and written-visual symbol systems groups showed more positive attitudes compared to only visual symbol systems groups. This finding yields important clues for instructional designers, teachers, program producers and textbook writers. Because adaptation to any content can only be possible by focusing on the media. This requires the design of learning materials and symbol systems in a way that they will get their attention and attract them (Wittrock, 1990).

In the content part of the attitude scale, only written symbol systems groups and written-visual symbol systems groups in distance education exhibit more positive attitudes in understanding the content. This shows that in distance education, only the visual symbol systems are not enough to affect achievement. This finding supports Pezdek and Stevens (1984).

On the other hand, groups studying only with the written symbol systems in traditional education, exhibit more positive attitudes in understanding of the content. This implies that the book is the most effective material for understanding the content. This finding supports Salomon (1984). According to him, printed materials are perceived to be requiring more efforts and investment.

Time-on-task

The time students spent on completing the instructional materials are significant in both teaching method and symbol systems variables. Distance education students spent more time than the traditional groups. Groups using written and visual symbol systems together spent more time than those using only written or only visual symbol systems. To see how these two variables effect each other, Fisher LSD test processed and according to the results, distance learning groups in both written and visual symbol systems compared to other five groups. Traditional face-to-face group spend less time to complete the material than other groups.

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Looking at their achievement score means, results show that there is a positive correlation between time-on-task and students' achievement in distance written and visual groups. While the traditional written symbol group use less time for learning, still they are more successful comparing to other groups. The reason for this success of students in this group might be related to their ability levels and entry learning behavior levels. Different researches in the literature suggest that learning content from different materials and symbol systems might change as a result of their entry behaviors and abilities of students.(Eckhardt, Wood and Jacobwitz, 1991; Van der Molen and Van Der Voort, 1997; 1998). This effects student achievement either positively or negatively.

Future research is needed to see whether the findings are correlated to entry behaviors and abilities.

Result of the retention of learning test was conducted two weeks after the achievemet test. The test indicated that each group's achievement points were decreased. Formal students were more successful than the distance students at the retention test. If we look at the symbol systems' point of view, formal group students who have used symbol systems were more succesful than the other groups. Distance education students who have used the verbal and video symbol systems were more succesful than the other groups.

Recall sub division of the retention test's statistical results indicated that there were some differantiation between the achievement tests' sub divisions. Formal-verbal was the most successful group in the context of achievement-recall. In conrats verbal-visual group were the most succesful in vebal-visual context. Those results supports that the idea of visual knowledge can be stayed more than a week in memory (Bagget and Ehrenfeucht, 1983), and if visual-verbal knowledge can be presented together those knowledge effects the students' achievement (Plass, Lautner, Chun, and Mayer, 1998).

Formal written group is seen the most successful group in the comprehension sub division of retention test while the formal written and visual group is the most successful in the comprehension sub division of achievement test. On the other hand, the formal education learners' interaction level with symbol systems reveals that formal written group is more successful in retention-comprehension while formal written and visual group leads in achievement-comprehension. These findings can be interpreted as that formal education learners use mostly use verbal strategies in the mental information processing.

The responds of students related to confidence show no significant difference neither for instructional strategy nor symbol systems. Decreases can be seen in the relationship between students' actual grades and indicated confidence responses, and retention-confidence level of each group compare to achievement-confidence. Positive and significant relation between in the retention test grades and in confidence grades is also observed same as relation between achievement and confidence.

Another decrease can also be noticed in each groups' means of confidence level related to retention test when achievement-confidence means of the groups and the means of confidence level related to retention test are compared. Same as achievement test confidence means, groups studied only visual symbol systems got better confidence scores than others. According to these findings, it can be claimed that visual materials are perceived easier than printed materials.

In the light of all the findings indicated above, it can be told that use of different symbol systems for learners in formal and distance education settings shows assorted effects on learners' achievement, attitudes, confidence, time-on-task and retention of learning. So that, in order to enable learners with diverse characteristics to get benefits from various symbol systems, instructional media must be designed and utilized appropriately.

Suggestions

According to the results of this investigation and the experiences gained during the study, following suggestions are offered for both practitioners and researchers.

Different symbol systems do influence the achievement in different ways. So that, instructional designers (practitioners) should pay attention to learners' individual characteristics and distinctiveness of symbol systems in order to provide effective, efficient and appealing distance learning opportunities as well as formal learning practices in every phases of instructional design process.

As with any research effort, this one raised a number of compelling questions worth further exploration. First, distance learners' individual characteristics such as age, sex, learning style might influence the effective use of different symbol systems. Thus, people who are interested in symbol systems (researchers) in distance education can investigate the relationship between these characteristics and symbol systems.

Second, effects of learners' prerequisite skills about instructional content on distance learners' symbol system preferences is another topic worth further investigation. Third, the instructional content of this study was a social science, anthropology. The effects of symbol systems might differ on another instructional content. In other words similar investigations should be conducted in different content areas such as sciences, mathematics.

Forth, another point is that sometimes learners might find the content more important than the symbol system or vice versa. In another investigation this point might be examined to clarify in distance education.

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